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A Contribution to the Life History of *Colobura* (*Gynaecia* auct.) *dirce dirce* (Linnaeus). (Butterfly)[1]

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(Plates I & II)

[This paper is one of a series emanating from the tropical Field Station of the New York Zoological Society, at Simla, Arima Valley, Trinidad, British West Indies. This station was founded in 1950 by the Zoological Society's Department of Tropical Research, under the direction of Dr. William Beebe. It comprises 200 acres in the middle of the Northern Range, which includes large stretches of undisturbed government forest reserves. The laboratory of the station is intended for research in tropical ecology and in animal behavior. The altitude of the research area is 500 to 1,800 feet, with an annual rainfall of more than 100 inches.

For further ecological details of meterology and biotic zones see "Introduction to the Ecology of the Arima Valley, Trinidad, B. W. I.," William Beebe. (*Zoologica,* 1952, Vol. 37, No. 13, pp. 157-184).]

THERE are several sporadic accounts of the life history of the Zebra Butterfly, *Colobura* (*Gynaecia* auct.) *dirce dirce* (Linnaeus), (Sepp, 1852; Cockerell, 1892; Panton, 1893; Dyar, 1912). In none of these is there mention of an unusual habit of the first few instars of the caterpillars. This seems worthy of record.

On March 2, 1951, two unidentified butterfly eggs (No. 5177 A & B) were brought to the New York Zoological Society's laboratory at Simla, in north-central Trinidad. They were attached to the upper side of a cecropia leaf (*Cecropia peltata*), about an egg diameter apart. The eggs were slightly flattened spheres, attached by one pole. Their diameter was .85 mm. The surface was olive-green and quite smooth. Each egg was encircled by fourteen vertical, conspicuous, raised ribs or ridges, compressed and high, standing out distinctly from the surface. These were pale steel-blue and extended from pole to pole. The general facies was reminiscent of the eggs of our northern nymphalids *Vanessa atalanta* and *Precis lavinia.* The principal difference was the absence of any apparent cross lines between the ridges. Careful low power examination showed no trace of the lines, but their visual absence may be accounted for by the advanced stage of incubation.

The observations that follow are extracts from my laboratory journal.

MARCH 3, 1951. LARVA NO. 1

Both eggs hatched early this morning, about seven o'clock, within a few minutes of each other. The caterpillars ate a little of their eggshells, then walked away. I kept Number One under observation. It was 2.8 mm in length, with a large, dark-brown head and pale green body covered with a sparse growth of simple, short, inconspicuous hairs. It ate a narrow, winding band out of the leaf substance, then took up a position at the edge of the leaf. Here it reared up and became as rigid and motionless as a geometrid measuring-worm.

A few hours later, at one-thirty P.M., it was close to its first position but was now clinging to a very slender shred or column of some material projecting from the contour of the leaf. The thread-like shred was shorter than the larva, 1.7 mm overall. As the larva clung to the shred, its head and forelegs projected beyond the tip. Its head was connected with the shred by a strand of silk.

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As I watched, the caterpillar suddenly snapped or cut the silk and bent the anterior half of its body around, doubling back on itself. At this moment a pellet of excrement appeared, and as it was ejected it was taken in the jaws of the larva, brought up to the tip of the column and pressed firmly down. A weaving of silk began at once, enshrouding figures-of-eight, wrapping about the pellet, attaching it firmly to the summit. Close examination now showed the column to consist of a succession of similar pellets, twelve altogether, plus two small spines from the surface of the leaf. In addition, there were a number of silken guy ropes, extending from various heights to points on the leaf a short distance away from the base of the column.

At five o'clock the column was 5.5 mm in height, twice the length of the caterpillar, which clung motionless to the distal half. I waited, and watched a fixation. The pellet was at first rather soft and yielded readily to downward pressure of the larval head, then being bound firmly with a thin coating of silk on all sides, over the top, and finally a strengthening of the adjoining pellets already in place.

There followed five minutes of quiescence, after which the stays were again severed and the larva climbed down and disappeared beneath the leaf. Soon its head appeared at the edge of a slight indentation, and twisting its head sideways, it began to gnaw, gradually forming a narrow, winding canal of eaten tissue. When finished, it had devoured an irregular form of about its own length and width. The column was rendered even less conspicuous by several of these chewed-out sections, scattered over the surface of the leaf.

Without delay the larva made its way back to the column, a distance of about four of its lengths, and climbed slowly to the summit. As it ascended, it wove a few more strands, twisting and turning about as it strengthened the structure. Again it anchored itself at the top. Fifteen minutes elapsed before the first of a new supply of building material was available.

At nine P.M. the column was three times the length of the builder, the slenderest of supports, much less in diameter than the small body of the larva. I now noticed five bits of broken pellets entangled in the dorsal hairs of its body, too many to be merely accidental, and adding appreciably to the confusing contour.

March 4, 1951

At eight A.M. Number One larva had extended its column to a height of 12 mm, and had eaten away some of the lateral leaf tissue near the base so that this added several millimeters to the total height. The base had its origin at the leaf's edge exactly at the termination of a main vein, thus ensuring a firmer foundation than the more pliable, veinless intervals would have provided.

March 3, 1951. Larva No. 2

I isolated the second caterpillar on a small bit of leaf that was not in water. After four hours it too had built itself a column, thus checking the achievement of its companion. Still later I found it vainly trying to gnaw the edge of the dried leaf. Provided with a fresh leaf it fed at once. Then began a long period of restless walking, around and around the edge of the bit of leaf. I realized that it was looking for its column which had been taken away with the first dried leaf. Now and then it went through a significant action. It stopped in midwalk, reached around, took a pellet from itself, placed it on the leaf edge, and half-heartedly made some figures-of-eight about it, then reared high in air, as if looking for the missing column. Then followed another spurt of walking. This recurred three times, a single pellet foundation being laid separately, with no further following up or revisiting.

There seemed to have been interrupted a sequence of instinctive actions which, with the beginning lost, refused to be correlated. Now and then the larva would stretch high up, and remain motionless after spinning a strand of silk from the leaf edge on which its rear legs were resting, up to its mouth. The guy rope was in place although there was nothing to guy.

March 4, 1951

Number Two has built itself a fresh column, proving that at least in the darkness of night it is not the victim of interrupted instinct that I feared it to be. In fashioning the distal half of the column, it seems to have run out of a full supply of silk, for the terminal pellets show a scant amount of binding material. The larva seems to distrust the holding strength of the column for it takes its stand well below the summit.

March 5, 1951

The columns of the two larvae have increased only slightly during the night, while the ground below is covered with pellets. When finished, the columns serve as roosting places, day and night. The newly extruded pellets are now much drier than when they were being used as malleable building units. (This recalls the physiological change from capsule-con-

tained excrement in nestling birds, to its abrupt disappearance when they leave the nest).

March 9, 1951

Both caterpillars are doing well. They have been weaned to fresh bits of leaf daily, while their respective columns are kept erect on bits of cork and so are available for constant roosts. They perch quietly most of the day and feed at night, the ground being black with pellets in the morning.

Today, after molting, they are 12 mm in length, and covered with long, stout, black, white-tipped spines. A pair of cephalic spines is much larger than those on the body.

March 12, 1951

Another molt has changed the spines from black and white to conspicuous yellow. With this change the caterpillars deserted their columns and now remain in full sight, all day, on the upper sides of the cecropia leaves.

(Until today I had had no idea of the identity of the two larvae. The appearance of the yellow spines recalled a former colored plate made a year ago. Reference to this showed that on June 1, 1950, a 36 mm caterpillar was brought in and changed to chrysalid on the 5th and emerged as a *Colobura dirce* on the 17th).

March 22, 1951

Molted into the full-grown larva four days ago. This evening they simultaneously climbed to the top of their terrarium and suspended themselves in the familiar J-shape, presaging pupation.

March 23, 1951

Still hanging unchanged until one P.M., when Number One began straining up and down. Within seven seconds the skin split at the lower head-end, and, assisted by slight writhings, slipped up and up until it was a puckered mass of spines at the top. There ensued several violent movements, and, quicker than my eye could follow, partly concealed behind the bunch of spines, the wrinkled, shrivelled skin slipped off and the cremaster was recaught in the webbing on the wire. The cast skin, after it fell to the ground, gave several unexpected twitches, mechanical of course, but seeming horribly like postmortem activities.

After the skin shedding there followed an interval of writhings, twistings and turnings as if to ensure the firm attachment of the cluster of hooks. At first the chrysalid was dark brown, but in twenty minutes it turned to pale gray. The dead wood appearance and the several sharp splinter-like projections gave it perfect semblance to a bit of projecting dead wood.

April 4, 1951

This morning the yellow forewing band of the imago showed clearly through the pupal skin, and at 9:30 A.M., within a few minutes of each other, both butterflies emerged.

As I was examining one of the pellet columns, Dr. Marston Bates happened to come into the Trinidad laboratory, and told me he had observed a similar habit in a related species of nymphalid in Colombia.

Note on Pellets

The pellets, after passing through the intestine, consist of many bits of green leaf, almost unchanged from their original appearance. One, when dissected, revealed thirty-six minute pieces of leaf compressed into a ball. From the individual irregularities of outline, it might be possible, like a jigsaw puzzle, to fit them together. In the present instance they play an important part in the life of the caterpillar before being reduced to their original elements by bacteria.

Note on Courtship

On June 24 saw a pair of Zebra Butterflies feeding on a half-rotten cashew. They flew up, fluttering around one another, and alighted close together on the underside of a small branch. The larger, the female, faced in one direction and close behind her the male faced toward her. She opened and closed her wings in a small arc very slowly. The male began a succession of small, quick snaps of body and wings. In twenty minutes he had advanced an inch toward her, and when he finally touched her with his unrolled tongue, she took off and he instantly followed closely. The male jerks were accompanied with low, soft snaps. The episode ended as abruptly as it began.

Summary

Two eggs of *Colobura dirce dirce* (Linnaeus) hatched into caterpillars which immediately exhibited a very specialized type of behavior pattern. They utilized extruded pellets, erecting them into a column of considerable height, binding them with silk, the whole resembling a shred of dried leaf. In the intervals of brief feeding they rested quietly in an extended pose on the summit of the columns, guyed and steadied with silken threads.

After several molts a dense armor of sharp, radiating, bright yellow spines was acquired, conspicuous in distinct contrast to the black body color. Simultaneously, the cryptic phase of behavior gave place to one of definite ex-

posure, the larvae resting through the hours of daylight in full view on the upper side of leaves, presumably an example of warning coloration.

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EXPLANATION OF THE PLATES

Plate I

Fig. 1. Young caterpillar on column, affixing a pellet to the summit. Observe the narrow canal of eaten leaf tissue, which has provided architectural building material as well as food.

Fig. 2. Completed pellet column, with caterpillar resting at the summit, the whole simulating a shred of torn dead leaf.

Fig. 3. Eggs. × 17.

Figs. 4, 5 and 6. Successive stages of the caterpillar.

Plate II

Fig. 7. Full-grown caterpillar. × 4.

Figs. 1 and 2. Photographs by Jocelyn Crane.

Figs. 3, 4, 5 and 6. Paintings by John Cody.

Fig. 7. Painting by Douglas Boyden.